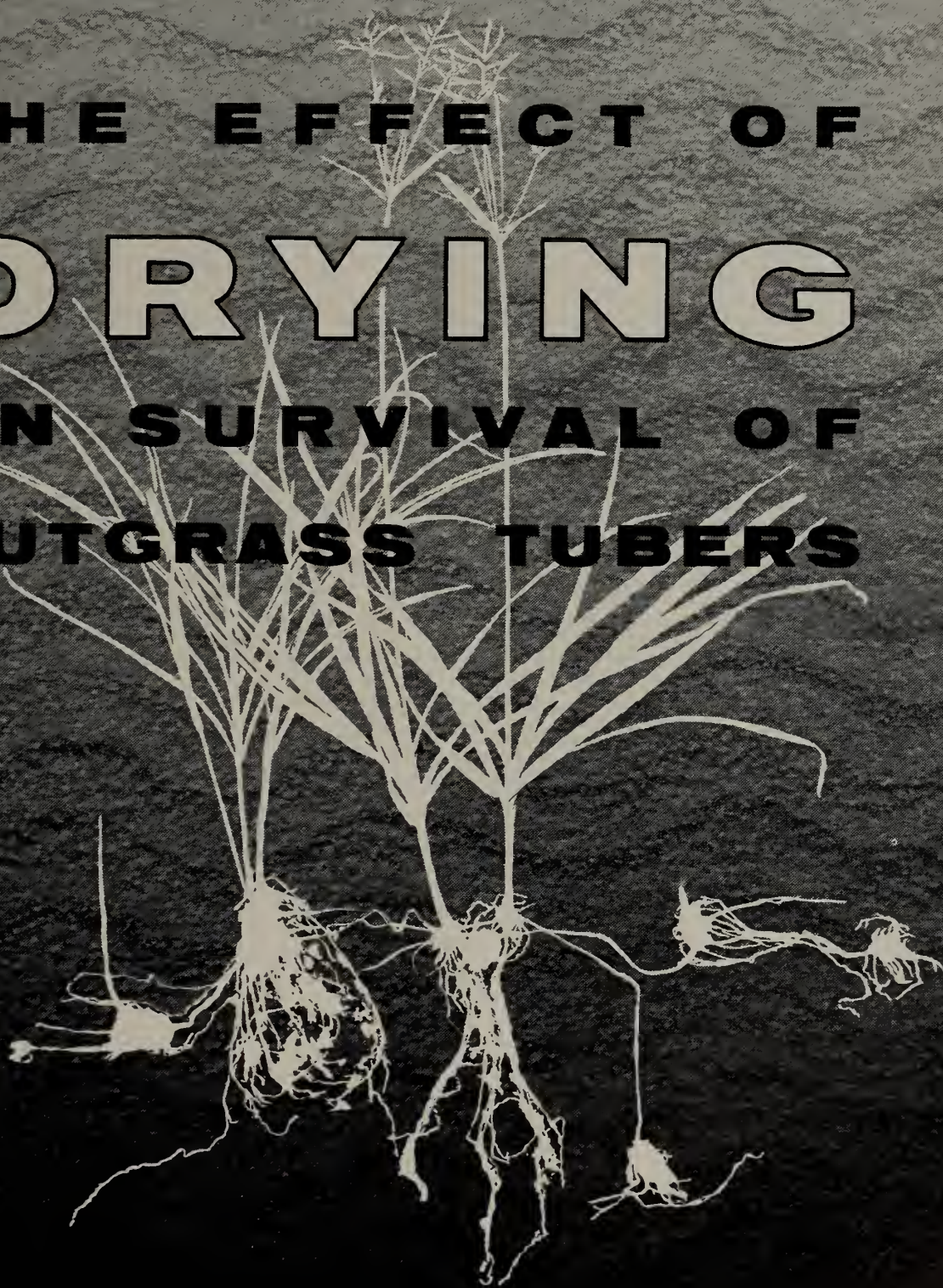




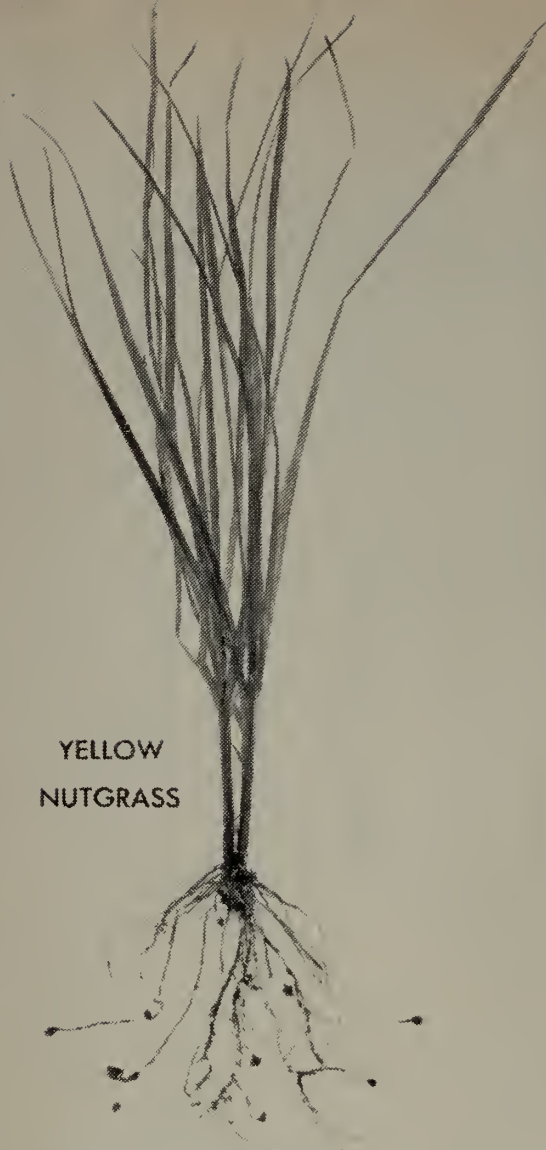
Division of Agricultural Sciences
UNIVERSITY OF CALIFORNIA

**THE EFFECT OF
DRYING
ON SURVIVAL OF
NUTGRASS TUBERS**



Boysie E. Day

Robert C. Russell



Tubers of two species of nutgrass—purple and yellow—were exposed to dry air and dry soil in the laboratory and under field conditions.

Purple nutgrass tubers were readily killed by drying in open air and by deep plowing in dry soil.

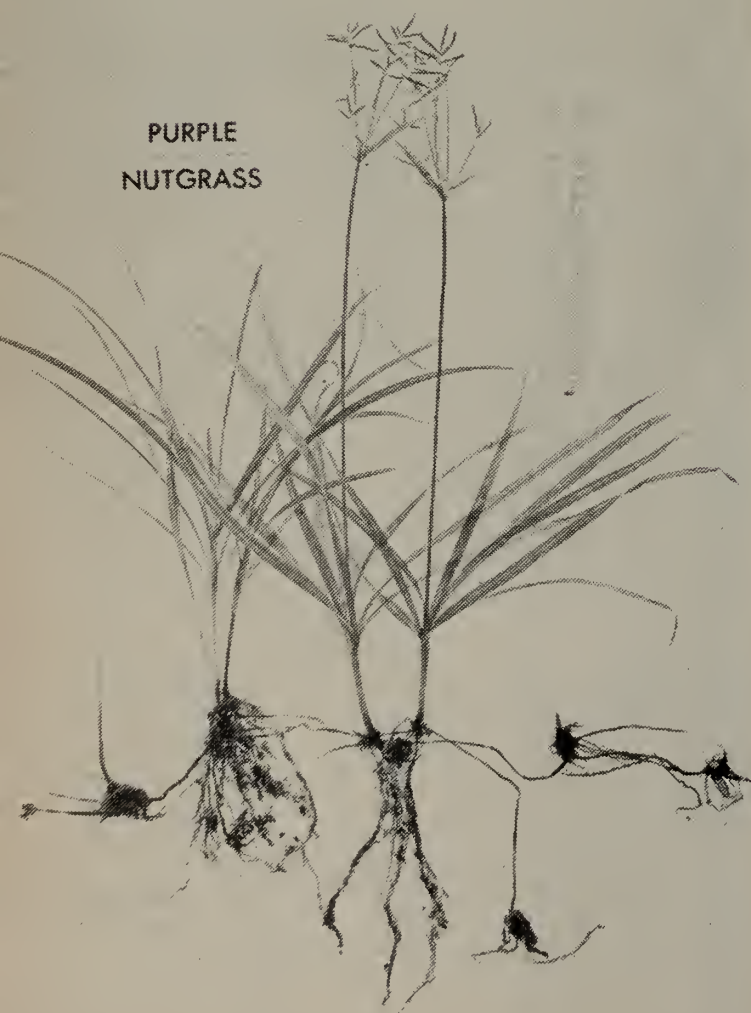
Yellow nutgrass tubers survived prolonged storage under air-dry conditions.

A tillage program aimed at control by drying tubers would be expected to succeed with purple nutgrass, but fail with the yellow species. Before planning such a program, therefore, the grower must know for certain which species of nutgrass is present.

The two species may best be distinguished by the taste of the tubers.

Yellow nutgrass tubers have an almond-like, pleasant taste. Purple nutgrass tubers have a bitter, pungent flavor.

In the illustrations at left, each plant is two months old, and each was grown from a single tuber. Both show typical growth habits—small tubers on the ends of short rhizomes (yellow nutgrass); an interconnected system of tubers and rhizomes (purple nutgrass).



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The Effect of Drying on Survival of Nutgrass Tubers¹

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Two tuber-producing sedges have become established in California—purple nutgrass (*Cyperus rotundus* L.) and yellow nutgrass (*C. esculentus* L.). Both are serious weeds on cultivated land. These plants are spread chiefly by means of their tubers and rhizomes. Control is difficult because the numerous tubers in the soil are a source of new shoots that redevelop rapidly following tillage or chemical treatment of the tops.

Although little study has been devoted to methods of controlling yellow nutgrass, techniques for controlling purple nutgrass have been under investigation for a number of years. As a result, fumigation has been found to be both effective and practical in eliminating smaller infestations (Day, 1953; Leonard and Harris, 1950; Loustalot and Leonard, 1948),² but it is not feasible for large areas because of the high cost. Other chemical methods are not widely used because of high cost or limited effectiveness. Economical methods for control of large infestations are needed.

Studies of tillage methods in the southeastern states (Smith and Mayton, 1939, 1942) and in Arizona (Davis and Haw-

kins, 1943) concluded that frequent cultivation for two years was necessary for effective control of purple nutgrass. Smith and Mayton (1942) found that plowing every three weeks for two years resulted in control except on poorly drained soils. Other experiments have also demonstrated the importance of water relations in tuber survival. It has been shown (Ranade and Burns, 1925; Andrews, 1940*a*, 1940*b*; Davis and Hawkins, 1943) that tubers exposed to the open air or stored in dry soil soon die as a result of drying. Andrews (1940*a*, 1940*b*) reports that one deep plowing in dry soil gave successful control of nutgrass in the Sudan Gezira under climatic conditions similar to those of the interior valleys of California. Davis and Hawkins (1943) found that repeated tillage to increasing depths up to 12 inches, over a period of three months, under dry conditions in Arizona reduced the tuber population to a very low level. However, these workers report that irrigation each month and cultivation once a week are superior to tillage under dry conditions as a means of controlling this weed.

Growers' reports in California on the effectiveness of tillage are variable and often contradictory, perhaps because of a general failure to distinguish between the species of nutgrass.

¹ Paper No. 849, University of California Citrus Experiment Station, Riverside.

² See "Literature Cited" for citations, referred to in the text by author and date.

HOW TO RECOGNIZE THE TWO SPECIES

Yellow and purple nutgrasses are similar in general appearance. The aerial portions of the plants closely resemble grasses, but can be distinguished from the true grasses by their triangular stems and closed leaf sheaths. The tubers or nutlets are borne on thread-like rhizomes which are commonly mistaken for roots.

Yellow nutgrass is a somewhat lighter shade of green and is slightly taller and more robust than the other species. The nutlets are smaller and less scaly, and are usually found on the ends of short rhizomes that radiate from the crowns of the plants. (See photo, inside front cover, and fig. 1.)

Purple nutgrass has tubers that are covered with a brown, fibrous coat. They occur typically in chains that extend both laterally and downward from the mother

plant. (See photo, inside front cover, and fig. 1.)

Taste of the tubers is the best test for distinguishing between the two species. Yellow nutgrass tubers have a pleasant, nut-like flavor similar to the almond. The common name, "ground-almond," often applied to the nutlets, is properly descriptive. The tubers of purple nutgrass have a musty, tannin-like, bitter taste with a lingering, pungent after-flavor.

LABORATORY METHODS

Experiments were carried out to determine the time required to kill tubers by exposure to the open air, by vacuum drying, and by storage in dry soil.

Purple nutgrass. Tubers of purple nutgrass were collected in the field, washed, and trimmed free of roots and rhizomes. Samples of 50 uniform tubers

Fig. 1. Mature tubers of purple nutgrass (upper row) and yellow nutgrass (lower row), showing relative size and typical appearance.



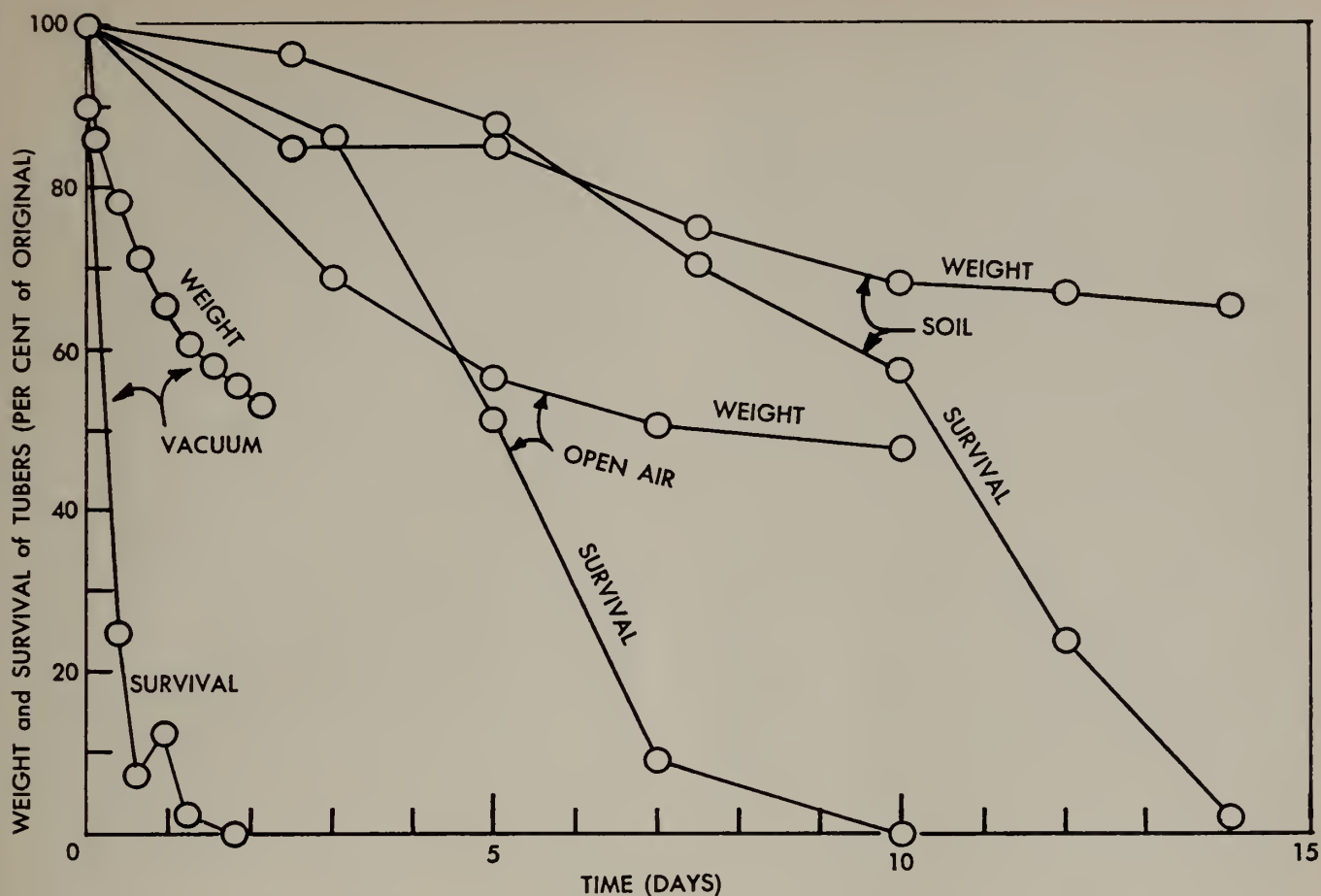


Fig. 2. Weight loss and survival of purple nutgrass tubers during drying under three different conditions.

each were stored in the laboratory under the following conditions:

1. In screen baskets, in a vacuum desiccator at 39° C with pressure reduced to less than 1 mm of mercury.

2. In open petri dishes, in a laboratory having a daily temperature range of 18° to 24° C and a humidity range of 30 to 60 per cent.

3. Distributed through air-dry soil in 1-gallon cans. The soil was Ramona sandy loam containing 0.23 per cent moisture (air-dry).

The moisture content of tubers was determined at the beginning of the experiment by drying a sample to constant weight in a vacuum oven at 60° C. At frequent intervals during drying, moisture loss was determined by weighing samples, and viability was determined by soaking the tubers in water and planting them on heavy blotting paper in a moist germinator at 30° C.

Yellow nutgrass. The relationship between drying and viability of yellow

nutgrass was determined by storing three samples of 50 tubers each in dry soils and measuring weight loss and viability at frequent intervals.

Results. Figure 2 shows the results obtained from drying samples of 50 purple nutgrass tubers under the three conditions listed above. The initial moisture

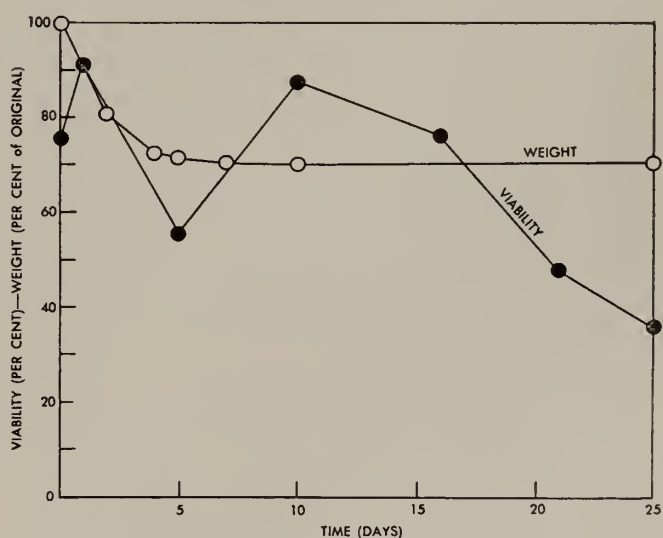


Fig. 3. Weight loss and survival of yellow nutgrass tubers buried in air-dry soil in 1-gallon cans at room temperature.

content of the tubers was 58 per cent and 61 per cent, respectively, in replicate determinations.

Data on moisture loss and viability of yellow nutgrass in dry soil are given in Figure 3. The tubers lost moisture rapidly, and reached a constant weight of 71 per cent of the original in seven days. Germination was erratic with a decreasing trend. The experiment was terminated after 25 days, at which time 36 per cent of the tubers were viable. In another experiment, air-dry tubers of yellow nutgrass were stored at room temperature for six months with little loss of viability.

It is apparent that tubers of purple nutgrass are killed by drying, and that tubers of yellow nutgrass are not. Unlike many fleshy plant organs (for example, the potato tuber and onion bulb), nutgrass tubers of both species have no well-developed mechanism for moisture retention. Yellow nutgrass tubers are like the tissues of seeds and spores in that they remain dormant during prolonged periods of dryness.

FIELD STUDIES

During the 1952 growing season, experiments were conducted in a field near Upland, California, in which there was a heavy stand of purple nutgrass. During previous seasons the field had been used to grow a deciduous orchard. Beginning in April, the field was cultivated to a depth of 6 inches by disking at intervals of three to four weeks. A portion of the field was irrigated frequently throughout the summer. The other area was not irrigated, and by July the soil became thoroughly dry to a depth of 15 to 18 inches. A third part of the same field, near an irrigation standpipe, was constantly moist throughout the growing season but had not been tilled for several years (moist-untilled). Following disking in July, no nutgrass or other plant growth reappeared on the unirrigated portion of the field (dry-tilled treatment). In the irrigated portion (moist-tilled), luxuriant

growth of nutgrass reappeared after each tillage throughout the season. During the period October 11 to 16, pits were dug in the dry-tilled, moist-tilled, and moist-untilled areas, and the nutgrass tubers were carefully separated from the soil. Each pit was 1 square yard in area. All the tubers in each 3-inch level of the pits were screened out, and their viability was determined by planting them on moist blotters in a seed germinator.

Results. Data are shown in Figure 4. Tubers in the tilled upper 6 inches in the dry area were nearly all shriveled and dead. Most of the tubers in the 6-inch to 9-inch horizon and the 9-inch to 12-inch horizon, although in dry soil, were alive. The moist-tilled area contained a high proportion of dead tubers and a much greater population of tubers than was present in the dry-tilled area. The moist-untilled area contained few dead tubers, and most of the tubers were concentrated in the upper 9 inches of soil. It is apparent that tillage under dry conditions is a highly effective means of killing the tubers, and that drought alone or tillage alone is less effective than are the two combined.

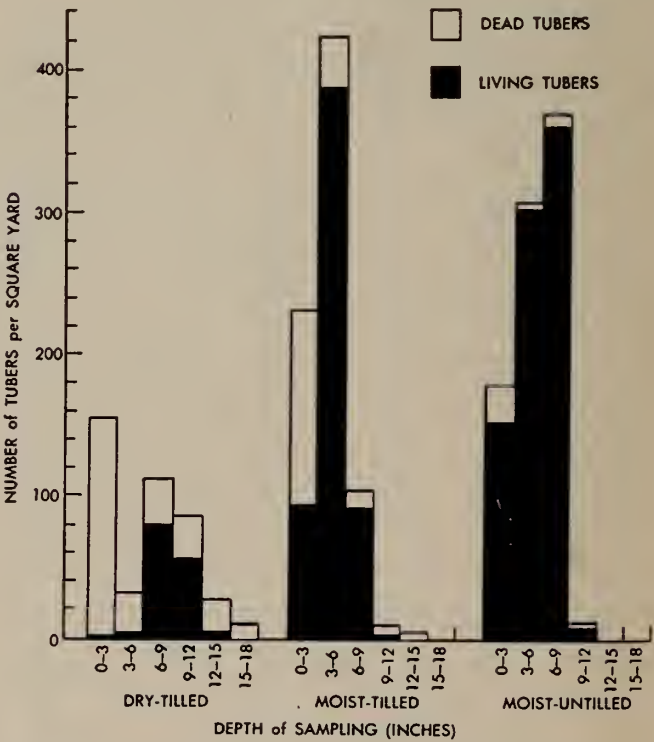


Fig. 4. Number and viability of purple nutgrass tubers under three management practices.

DEEP TILLAGE

A study was made of the effectiveness of deep tillage of dry soil as a means of control under California conditions. Near Upland, a 1-acre field containing a heavy infestation of nutgrass was plowed on August 12, 1952, to a depth of 14 inches. The soil was thoroughly dry to the depth plowed, and was moist at lower depths. Samples of soil were screened from time to time to collect tubers for viability determinations.

Results. Of an initial sample of 330 tubers, 48 (14.5 per cent) were viable. Nearly all of the dead tubers were shriveled, presumably as a result of drought. On the sixth day following plowing, a sample of 335 tubers collected from a pit dug to the plowsole showed 46 (13.7 per

cent) alive. On the sixteenth day, a sample of 157 tubers contained none that was alive. On the twenty-third day, one tuber out of a sample of 101 was viable. This surviving tuber was removed from a depth of 14 inches adjacent to the plowsole, and perhaps had not been severed from its roots. In several subsequent samplings, no viable tubers were found. Ten weeks after plowing (October 28), six nutgrass shoots had appeared above the surface of the plowed area. Excavation revealed that these had all arisen from tubers germinating in the moist soil from 15 to 20 inches below the surface, and below the depth of the plow. No nutgrass grew in the field the following season although conditions were suitable for its growth.

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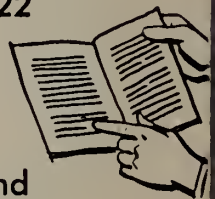


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